The Use of Oral Progestogens in Controlling the Estrous Cycle of Beef Cows and Heifers

E. J. Turman, J. E. Tilton, R. H. Edwards, T. D. Rich, R. L. Willham, Robert Renbarger and D. F. Stephens

Beef cattle producers must be constantly on the alert for any new technique that promises to increase the returns to a beef cow enterprise. The goal must be to have every cow in the herd producing at the maximum—in other words to start producing as early in life as possible, and thereafter be a regular producer of a heavy, high quality calf.

Artificial insemination is such a technique. It is widely used in dairy cattle herds, and probably has been the single, most important factor in dairy cattle improvement over the past 20 years. Although offering the same opportunity for the improvement of the beef herds, it has been used only on a very limited basis. Specific management problems that are peculiar to beef cattle herds have been the primary reasons why its use has been limited, particularly in commercial cow herds. Probably the most important of these problems is associated with the difficulties encountered in detecting heat in cows under range conditions. In most commercial herds the additional labor that would be required to do this over the entire breeding season greatly limits, and in many herds prohibits, the use of artificial insemination.

There is every reason to believe that artificial insemination would be much more widely used in beef herds if it was possible to reduce the difficulties presently associated with estrus detection. One of the most promising developments in this direction is estrus synchronization, which would result in all of the cows in a herd coming in heat within a few predictable days. Thus, the rancher could concentrate on heat detection and breeding only on these days and forget about it for the remainder of the days of that cycle.

Estrus synchronization was successfully accomplished on a research basis more than twenty years ago by means of injections of progesterone. However, among other shortcomings, this technique was not adaptable to practical management. The development, in recent years, of the oral progestogens—compounds with the same physiological activity as progesterone but effective when fed—has stimulated additional work in estrus synchronization. This work has progressed to the point where several pharmaceutical houses either now have, or soon will have, such compounds on the market.

Progesterone is an important hormone in the female reproductive cycle. There is, therefore, the possibility that the oral progestogens may have a number of other important applications in livestock production. One possibility that deserves study is that it may have an effect on the length of the post-partum interval from calving to first estrus. In most beef cows this period is some 60 days in length and is not a problem. However, in some cows, particularly young cows, this period may be unusually long and result in calving intervals considerably longer than

12 months. If these orally effective progesterone-like compounds can be used in cycling females to control the estrual cycle, there is the possibility that such compounds may be able to stimulate an earlier resumption of estrual activity in lactating cows.

This is a report of studies conducted over a three year period on the effect of an oral progestogen, 6-methyl-17 acetoxyprogesterone (MAP)[1] on: (1) The synchronization of estrus in cycling beef heifers and lactating 2- and 3-year old beef cows and the fertility at these synchronized estrus periods; and (2) Reducing the length of the post-partum interval from calving to first estrus and/or conception in 2- and 3-year old beef cows.

Materials and Methods

A total of five trials were conducted over a three year period at the Ft. Reno Research Station. Two trials (trials 1 and 2) were concerned with yearling heifers, and three trials (trials 3, 4 and 5) with lactating 2- or 3-year old cows which had calved in February and March. In all trials the oral progestogen used, 6-methyl-17 acetoxyprogesterone (MAP) was fed daily at a level of 180 mg./head/day for 18 days.

In most trials the cows and heifers were a part of other studies and, as a consequence, management practices differed somewhat between trials. However, within each trial the animals in the control and treated groups were managed as nearly alike as possible. Except in trial 2, the cattle were wintered on dry native grass pasture supplemented with 2 lb. cottonseed meal per day plus enough ground milo to maintain desired weight gains.

The breeding season was of approximately 3 months duration, with the time of starting varying somewhat but terminating in all trials on August 1. Breeding dates during the period of pasture mating were obtained by carefully checking the breeding pastures at least twice daily. The occurrence of estrus at times other than during the breeding season was determined by means of vasectomized teaser bulls running with the females. The cows and heifers were checked in October for pregnancy and an estimate made of the date of conception. In addition, in most trials, calving dates in the subsequent calving season were available to check these estimates of conception dates.

Summaries of the results of trials 1 and 2 are presented together in Tables 1 and 2 because they represent the response to be expected in cycling, non-lactating heifers. Likewise, the results of the trials with lactating 2- and 3-year old heifers (trials 3, 4 and 5) are presented together in Tables 3 and 4. However, because the trials were carried out under different conditions, the results of each trial must be considered separately and not compared directly to another trial. It is possible, however, to consider trends that emerge as trials of a similar nature are considered as a group.

[1] Repromix, The Upjohn Company, Kalamazoo, Michigan.

Results and Discussion

Trial 1. This trial was carried out in the Spring, 1964 to study the estrual response of cycling yearling heifers to MAP, and to compare the fertility to artificial insemination at the first and second post-treatment estrus. Sixty yearling Hereford heifers, 12 to 15 months of age and averaging 550 lbs. in weight, were divided into two groups of 30. Group 1 was scheduled to be inseminated at the second post-treatment estrus, and group 2 was scheduled to be inseminated at the first post-treatment estrus. To permit artificially inseminating all heifers during the same period, the time of starting MAP feeding was staggered. The heifers of group 1 were fed MAP for 18 days, March 25 to April 11. Following MAP they were checked for date of occurrence of first estrus but not bred. The heifers of group 2 were fed MAP for 18 days, April 15 tc May 2. Artificial insemination of both groups was begun May 1 and carried out for 6 days.

All artificial inseminations were made by an experienced inseminator from a commercial bull stud. The frozen semen that was used was prepared from a single ejaculate of a Red Angus bull with an excellent fertility record. Artificial insemination was practiced for only one service period. The heifers were then placed with Black Angus pickup bulls for which there was good progeny test evidence that they did not carry the recessive red gene. In this way the color of the crossbred calves would reveal, in borderline cases, whether the heifer had conceived to the artificial insemination or to natural service to the pickup bulls.

The data reported in Table 1 shows that good estrus synchronization was obtained when MAP was individually fed. Ninety percent of the 60 heifers were observed in estrus 1 to 6 days after the last feeding of MAP. The degree of synchronization is indicated by the fact that 76.7 percent were in heat by the end of day 3, with 55 percent in estrus on the second day.

Synchronization is also still apparent at the second estrus, since 95.3 percent of the 43 heifers observed for two heat periods were in estrus in a 9 day period from day 19 to day 27 after the last MAP feeding (Table 1). However, it should be noted that 88.5 percent were in estrus in a 6 day period, days 19 through 24. Thus, almost 90 percent of the heifers were observed in estrus within a 6 day period in both the first and second post-treatment estrus periods.

It is likely that these heifers were typical of the kind of heifers that would be expected to respond most favorably to the oral progestogens. All but 9 of the 60 heifers has been observed in first estrus, and it is likely that these nine would have attained puberty within the next few weeks. In addition they were a well bred, growthy group of heifers in excellent breeding condition.

Even with individual feeding, which should have insured that each heifer received her daily allotment of MAP, estrus was not completely suppressed during the MAP feeding period. There were 9 heifers (15 per-

Table 1. The occurrence of the first and second post treatment estrus in yearling heifers fed 180 mg. MAP/head/day for 18 days (Trials 1 and 2).

First Post-Treatment Estrus			Second Post-Treatment Estrus		
Days After Last MAP Feeding	Percent of Total Heifers on Experiment Observed in Estrus Trial I	Trial II	Days After Last MAP Feeding	Percent of Total Heifers on Experiment Observed in Estrus Trial I	Trial II
0	0	0	19	9.3	10.0
1	11.7	10.3	20	14.0	2.5
2	55.0	30.8	21	23.3	17.5
3	10.0	23.1	22	20.9	25.0
4	6.7	17.9	23	14.0	5.0
5	5.0	2.6	24	7.0	2.5
6	1.7	0	25	2.3	5.0
			26	2.3	7.5
			27	2.3	0
			28-32	0	12.5
No estrus Observed (%)	10.0	15.6		4.7	12.5
Number of Heifers Observed	60	39		43	40

cent) observed in estrus while on MAP treatment. However, estrus was synchronized in 6 of the 9 since they were also observed in estrus in the period 1-6 days after the last MAP feeding. This suggests that estrus while on treatment had little effect on subsequent synchronization after termination of feeding. The heifers were not palpated so it is not known whether they ovulated at this estrus while on treatment. Likewise, fertility at the post-treatment estrus of heifers that were in estrus while on treatment could not be checked. Only 1 of the 9 heifers showing estrus while on treatment was scheduled to be bred at the first post treatment estrus and she was one of the three heifers that did not return to estrus 1-6 days post-treatment.

The conception data is presented in Table 2. In this trial the conception to artificial insemination was low (33.3 percent), and was not affected by the post-treatment estrus at which it was carried out. The results reported by other researchers had indicated that this level of fertility might be expected at the first estrus, but fertility at the second estrus should be much better. It cannot be determined from the data available in this study whether the poor results obtained were the fault of the treatment, the semen or the inseminator. There is nothing to indicate, however, that the MAP treatment adversely affected conception rate during the entire breeding season. The overall conception rate of 93.9 percent is typical of what might be expected in a group of yearling heifers.

One observation that is not reported in the tables is worthy of mention. The heifers were bred artificially for 6 days, but calved to the artificial inseminations over a period of 19 days from January

Table 2. Conception data for yearling heifers following estrus synchronization by feeding 180 mg. MAP/head/day for 18 days (Trials 1 and 2).

Item	Trial 1 Bred A.I. on Post-treatment Estrus		Trial 2 MAP	
	First	Second	Treated	Controls
Total heifers on treatment	30	30	41	42
Number bred	24	24	38	37
Number conceived first svc.	8	8	26	22
Percent conceived first svc. (%)	33.3	33.3	63.4	52.4
Total conception for breeding season (%)	90.0	96.7	90.2	85.7
Number of open heifers	3	1	4	6
Avg. calving date in next calving season	Feb. 27	Feb. 28	Feb. 21	Mar. 1

29 to February 17. Thus, it is apparent that precise control of calving date cannot be obtained by estrus synchronization through the feeding of oral progestogens.

Trial 2: This trial was carried out in the Spring, 1965 to study the estrual response of cycling yearling heifers group fed MAP, and the fertility to natural service at the second post-treatment estrus. This trial utilized 23 Hereford and 61 Angus yearling replacement heifers from the purebred herds of the beef breeding project at the Ft. Reno Research Station. The heifers ranged in age from 12 to 15 months and from 400 lb. to 650 lb. in weight. They had been wintered on wheat pasture until February 1, and then placed on native grass supplemented by alfalfa hay. Beginning March 15 they were group fed 1.5 lb. cottonseed meal and 3 lb. ground milo per head per day.

These heifers, as part of the cattle breeding project, had been previously allotted to 21 different breeding groups. It was necessary to take these breeding group allotments into account in further allotting the heifers by breeds to one of the two treatment groups. Group 1 served as untreated controls, while group 2 received 180 mg. MAP/head/day for 18 days beginning on March 26. The daily dose of hormone was mixed into the daily allottment of 1.5 lb. cottonseed meal. The heifers were group fed, however, ample trough space was provided so that all heifers of a group could eat at one time in an effort to insure that each heifer received her daily allotment of MAP. This time schedule of MAP administration was selected to permit breeding to start at the usual time of May 1, at which time most of the heifers should be coming back in estrus for the second time after the end of the MAP feeding period. The heifers were not bred at the first post-treatment estrus, but they were checked for the occurrence of this estrus by means of vasectomized bulls.

The heifers were placed in their previously assigned breeding groups on May 1 and ran with a fertile bull until August 1. Since some of the

heifers were removed from the project before calving, the conception data presented in this report is based on observations of breeding dates as confirmed by rectal palpations.

Table 1 reveals that the estrual response following group feeding is comparable to that obtained following individual feeding. Estrus occurred in 84.4 percent of the heifers within 5 days after the last MAP feeding. As in trial 1 the largest percentage of heifers (30.8 percent) were observed in estrus on day 2. However, unlike trial 1, in which 86.6 percent of the heifers had been in heat by the end of day 3, 67.2 percent of the heifers in this trial were in heat in the same period.

A fair degree of synchronization was still evident in the second post-treatment estrus in which 75 percent of the heifers were observed in heat in the 9 days from day 19 to day 27. This compares to the 95.3 percent of the heifers in trial 1 observed in heat in the same period. In the 6 day period from day 19 to day 24 there were 62.5 percent of the heifers of trial 2 observed in heat, compared to 88.5 percent in trial 1.

Eleven (27 percent) of the heifers were observed in estrus while on treatment. However, 9 of the 11 (81.8 percent) were also observed in heat within 1-5 days after the end of MAP feeding, and 10 of the 11 mated in the first week of the breeding season with 6 conceiving. It is likely that this larger number of heifers in estrus while being group fed indicates all were not getting their full daily allotment of MAP. However, again, as in trial 1, estrus while on treatment does not appear to have had a marked effect on the response of the heifers to MAP.

Only 3 Hereford heifers (13.6 percent) and 37 Angus heifers (60.7 percent) had been observed in estrus prior to the start of MAP treatment. However, all of the heifers were apparently so near the point of attaining puberty that their response to MAP was typical of that observed in actively cycling heifers.

The conception data for trial 2 that is presented in Table 2 shows an advantage for MAP in every comparison, although the differences were not statistically significant. More MAP treated heifers conceived to first service (63.4 percent vs. 52.4 percent), more conceived during the entire breeding season (90.2 percent vs. 85.7 percent), and the MAP treated heifers conceived one week earlier on the average, as evidenced by the fact that they calved one week earlier in the subsequent calving season. This enhancement of reproductive performance at an estrus after the first post-MAP estrus has been reported by others.

All Trials With Cycling Yearling Heifers: In general the data obtained in these studies are typical of those reported by others. Treatment with MAP, and other oral progestogens, results in excellent synchronization of estrus in heifers at, or near, the age at which sexual maturity should occur. It is reasonable to expect to observe estrus in at least 90 percent of the heifers within 6 days in the first, and in 80 to 90 percent in a 6 day period the second post-treatment estrual period. The failure to observe this percentage of heifers in heat during this 6 day period of the second post-treatment estrus of trial 2 was likely

largely due to the difficulty of accurately checking the heifers spread through 21 different pastures.

The way in which this degree of estrus synchronization would facilitate artificial insemination should be obvious. The labor involved in heat detection and insemination could be concentrated into two six day periods with the reasonable expectation that 80-90 percent of the heifers would be inseminated. Thus, 80 to 90 percent of the herd could be bred artificially through two heat periods with an outlay of 12 days of labor compared to the approximately 40 days that would be necessary without synchronization.

The numbers of heifers that would be in heat within a few days would rule out breeding by natural service as it is normally done. One way estrus synchronization could be combined with natural service would be if large numbers of bulls were available, as in trial 2. Another possibility would be to stagger the heifers as to time they were started on and taken off MAP feeding. Under present conditions it is difficult to find practical management value for either of these practices.

The data obtained in these studies do not permit reaching definite conclusions as to the effect of MAP on fertility. However, in general they support the reports from other research workers. Most of these other studies have shown that fertility at the first estrus after MAP is reduced somewhat. They have also shown that fertility at the second post-treatment estrus can be expected to be as good, and in many cases better, than that observed in the controls. There have been no reports to suggest that MAP, or any other commonly used oral progestogen, has any detrimental effect on the overall conception record of the breeding season.

Trial 3: This trial was conducted in the Spring, 1964 primarily to study the effectiveness of an oral progestogen, in this case MAP, in reducing the post-partum interval from calving to first estrus in two year old heifers. It was hypothesized that MAP might cause an earlier regression of the corpus luteum present during lactation. If the persistence of this corpus luteum is the reason for a prolonged post-partum intervals, and MAP caused it to regress, there is the chance that the cow would be stimulated to an earlier return to reproductive activity following calving.

Thirty eight 2-year-old lactating Hereford heifers were used in this trial. At the time of calving, in February and March, they were alternately assigned to either the treated or control groups. The heifers of the treated group were individually placed on treatment as they reached the 25th day after calving, and were fed, individually, 180 mg. MAP/head/day for 18 days. Fertile Hereford bulls ran with the heifers of both groups following calving and fertile matings were permitted at the first post-partum estrus regardless of the date of occurrence.

The estrus response of the 2-year old cows of trial 3 to 180 mg. MAP/day for 18 days is in sharp contrast to that reported in trials 1

and 2 for cycling heifers. The data reported in Table 3 shows that only 22 percent of the cows that received MAP starting on the 25th day after calving responded with estrus within 6 days after cessation of MAP feeding.

The conception data reported in Table 4, suggests that MAP in some way inhibited the occurrence of estrus and/or conception since the average date of conception of MAP treated cows was one week later than that of the controls. While the overall conception rate of the MAP treated cows is less than that of the controls, 94.4 percent as compared to 100.0 percent, it is acceptable, and there is no reason to believe that the MAP treatment had a detrimental effect on fertility.

It is evident that young lactating beef cows do not respond to MAP treatment started within a month after calving in the same way as do cycling heifers. It is also apparent that this MAP treatment sequence is not effective in reducing the post-partum interval. Apparently the heifer requires a set period of time to recover from the after effects of pregnancy and to rebuild the uterus before starting another gestation period.

Trial 4: This trial, carried out in the Spring, 1965, was a further

Table 3. The occurrence of estrus in lactating 2- and 3-year old Hereford cows fed 180 mg. MAP/head/day for 18 days (Trials 3, 4 and 5).

		Trial					
		3	4				5
			2-Year Olds		3-Year Olds		
Item		MAP	MAP	MAP + E	MAP	MAP + E	MAP
Total number of cows		18	10	10	7	6	22
Observed in estrus:							
Prior to start of MAP	—No.	0	2	2	4	4	10
	— %	0	20.0	20.0	57.1	66.7	45.4
1-6 days post-MAP	—No.	4	5	4	5	3	16
	— %	22.2	50.0	40.0	71.4	50.0	72.7
Cows in estrus prior to start of MAP feeding that were:							
In estrus 1-6 days post-MAP	—No.	–	1	1	2	3	8
	— %	–	50.0	50.0	50.0	75.0	80.0
Not in estrus 1-6 days post-MAP	—No.	–	1	1	2	1	2
	— %	–	50.0	50.0	50.0	25.0	20.0
Avg. interval from calving to start of MAP feeding of:							
all cows (days)		25	46	46	57	54	48
Cows in estrus 1-6 days post-MAP (days)		25	50	66	64	63	53
Cows not in estrus 1-6 days post-MAP (days)		25	39	60	46	45	40

Table 4. Conception data for 2- and 3-year old cows bred following feeding of 180 mg. MAP/head/day for 18 days (Trials 3, 4 and 5).

Item	Number of Cows	Conception Rate		Avg. Date of Conception
		No.	Percent	
Trial 3 (1964)				
Control	20	20	100.0	May 9
MAP	18	17	94.4	May 16
Trial 4 (1965)				
Control	11	7	63.6	May 15
MAP	10	10	100.0	June 3
MAP + ECP	10	7	70.0	June 10
Trial 5 (1966)				
Control	24	24	100.0	May 28
MAP	22	22	100.0	May 23

study of the effectiveness of MAP in young lactating beef cows, in this case both 2- and 3-year old cows. This study was not primarily an attempt to shorten the post-partum interval, but rather was designed to study the effect on estrual activity if MAP treatment was delayed so that the last feeding would come just prior to the start of breeding season on May 1. There have been some reports that estrogen injections would hasten the regression of the corpus luteum. If this is true, the combination of MAP plus a single injection of estrogen should result in better estrual response than does MAP alone.

A total of 90 Hereford cows, 34 three-year olds and 56 two-year olds, that had calved in February and March were used in this trial. The 2-year old cows had been used in trial 1, and the 3-year olds had been used in trial 3. The cows were divided within age groups into three treatment groups: group 1, untreated controls; group 2, individually fed 180 mg. MAP/head/day for 18 days, April 8 to April 25; and group 3, the same MAP treatment as group 2 plus a single intramuscular injection of 1 mg. estradiol 17B (ECP)[2] on the second day of the MAP feeding period.

The breeding season was begun on April 26 with hand mating to six fertile mature Hereford bulls carried out for 10 days. Beginning May 3 the cows were divided into 5 groups and pasture mated to one mature Angus and 4 yearling Hereford bulls until August 1. Each yearling bull was assigned to a breeding pasture as pickup bull for approximately 15 cows. All bulls had been semen tested and were believed to be fertile.

The estrual response of the cows of this trial are presented in Table 3. Only a few (20 percent) of the two year old cows had resumed

[2] ECP, The Upjohn Company, Kalamazoo, Michigan. An oil soluble 17(beta) cyclopentylpropionate ester of alpha estradiol.

estrual activity following calving, whereas, well over one-half of the three year old cows had been observed in estrus prior to the beginning of MAP treatments. A greater percentage of cows in both age groups responded with an induced estrus 1 to 6 days after last MAP feeding, when fed MAP alone rather than when fed in combination with ECP. As can be seen in table 3, 50 percent of the 2-year old cows receiving MAP alone compared to 40 percent receiving MAP + ECP were observed in estrus in the period 1-6 days post MAP. Comparable figures for the 3-year olds were 71.4 percent and 50.0 percent, respectively.

Probably the most important comparison revealed in Table 3 relates to the average interval from calving to start of MAP feeding for the cows that were in estrus 1 to 6 days post-MAP compared to those that were not. There is a definite tendency for cows that respond to MAP by an induced estrus to be those that have the longer post-partum intervals, and presumably are those ready, or nearly ready, to resume estrual cycling. These observations are supported by other studies that have shown that most beef cows require an interval of at least 60 days after calving to resume estrual activity. The results of this study would also tend to support the results obtained in trial 3, that MAP is ineffective in reducing the post-partum interval.

The conception data presented in Table 4 for trial 4 is data on the 2-year old cows only. Although the yearling bulls used had been semen tested and appeared to be fertile, one failed to settle the cows he ran with. Since he had been assigned to one of the two groups of 3-year old cows, it was decided to eliminate all conception data on 3-year olds.

Two things are apparent from the limited amount of conception data reported for trial 4. One is the controls had a very poor conception record, in fact the poorest of any group. However, the controls that settled did so some two weeks sooner than did the cows fed MAP alone. The group receiving the combination of MAP and ECP were delayed an additional week in conception, and had a much poorer conception rate than did those receiving MAP alone.

It is doubtful if any conclusion should be based on the conception data obtained in this trial, other than it does not appear that MAP had any deterimental effect on fertility. It does seem safe to conclude that the results of this trial do not suggest any reason for using a combination of MAP feeding and estrogen injection, but rather would indicate that such should not be used.

Trial 5: This trial, conducted during the Spring, 1966, was a further study of the effectiveness of MAP in 3-year old lactating heifers. These heifers had been used in trial 4 and many had bred late and, thus, had calved late. For this reason it was believed necessary to delay beginning of MAP treatment to have as many heifers as possible near a post-partum interval of 60 days. This was based on trial 4 where the results suggested that the length of the post-partum interval was the critical factor governing response of lactating heifers to MAP. It was further desired to start breeding no later than May 10, hence the dates picked for MAP administration.

A total of 46 Hereford cows used in trial 4 in 1965 calved early enough in 1966 to be used in this trial. They were divided as equally as possible on calving date into a MAP treated and untreated group. The MAP treated group was individually fed 180 mg. MAP/head/day for 18 days, April 21 to May 8. Hand mating to fertile Hereford bulls was carried out for 7 days following the last MAP feeding. The cows were then pasture mated until August 1. The conception data that is reported is based on breeding dates obtained by twice daily checking of the pastures as confirmed by rectal palpations carried out in October.

As can be seen from the estrual data in Table 3 and conception data in Table 4, there was a very acceptable response to MAP shown by the heifers in this trial. There was a good estrual response, 72.7 percent of the MAP-treated heifers in estrus 1-6 days post-MAP, and a perfect conception record in both the MAP-treated and control heifers. Again, as in trial 4, the heifers showing estrus immediately following MAP tended to be the heifers with the longest interval from calving to start of MAP. It was not essential that a cow be in estrus prior to the onset of MAP feeding to respond with an induced estrus, since only 8 of the 16 in a post-MAP estrus had been observed in estrus prior to MAP feeding. However, the data obtained in this trial suggests that if a cow was returned to estrus after calving there is a good chance she will respond to MAP by an induced estrus. In this trial 45.4 percent of the cows had resumed estrual activity after calving, and of this number 80 percent responded to MAP by coming into estrus 1-6 days post-MAP.

All Trials With Lactating Heifers: The results obtained in the three trials reported in this paper indicate that at least two factors detremine the effectiveness of MAP in synchronizing estrus in lactating heifers. One is the age of the heifers and the other is the length of the interval between calving and the start of MAP.

There appeared to be a tendency for 3-year old heifers to respond more readily to MAP than did 2-year old heifers. This might be expected since the reproductive performance of heifers at 2 years of age is usually well below what it will be at any other age. No data is available to indicate how much improvement, if any, in the response to MAP might be expected in mature cows over that observed in 3-year old heifers.

It would appear that if lactating cows are at, or very near, the post-partum interval at which they would normally resume estrual activity, they can be expected to show an estrual response to MAP similar to that observed in yearling heifers. It would appear, therefore, from the results of these trials that if a good response to MAP is desired, feeding should not start earlier than 50 to 60 days after calving. Only a limited number of cows that are treated shortly after calving can be expected to respond with an induced estrus. It also does not appear that MAP offers promise as a means of reducing the post-partum interval from calving to first estrus.